Tracking the Recovery of Onondaga Lake, NY:

Monitoring the Effect of Gray and Green Infrastructure Improvements in Achieving Phosphorus TMDL Numerical Water Quality Targets

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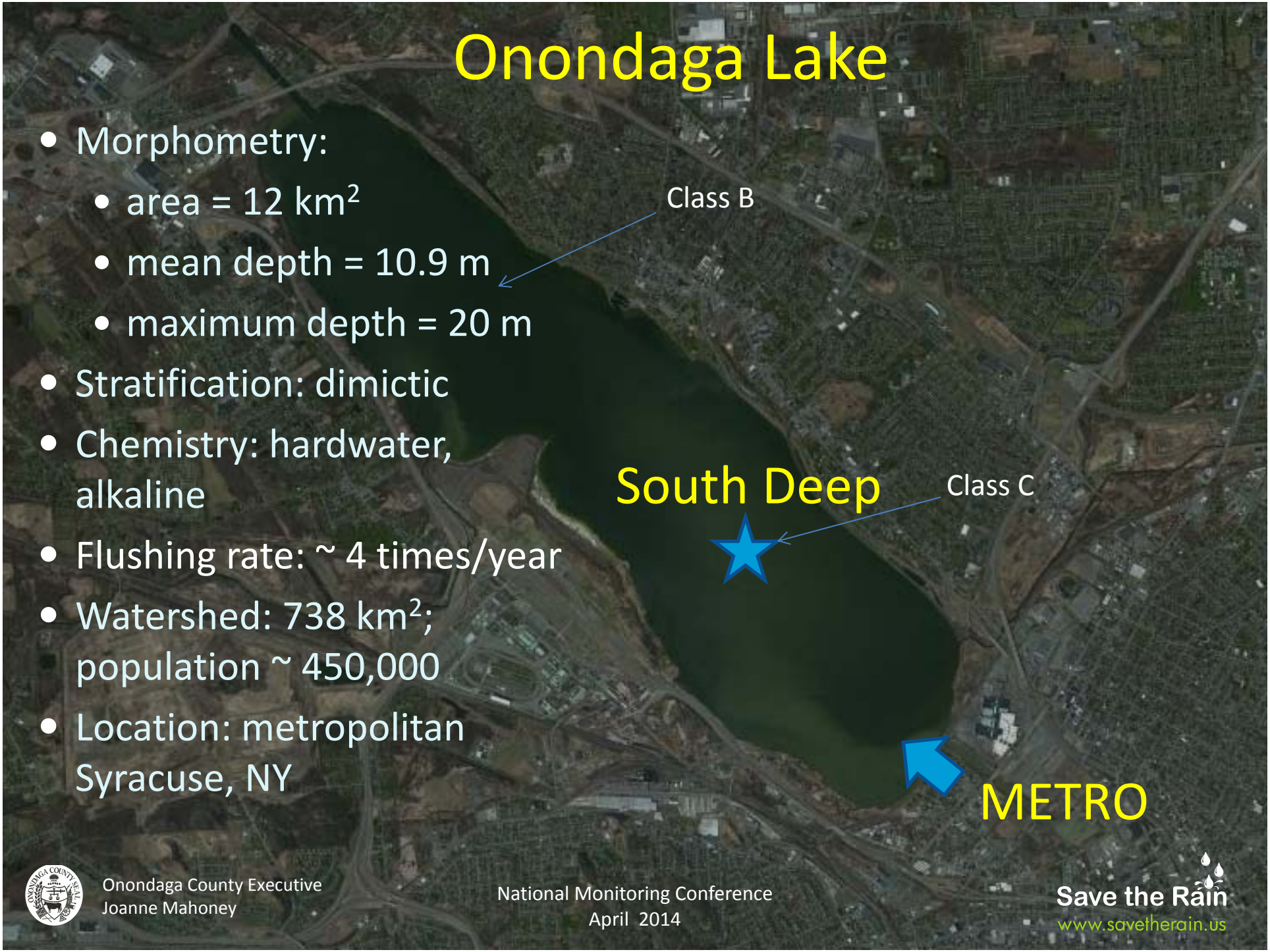
Save the Rain
www.savetherain.us

Presentation Overview

- Onondaga Lake and Historic Water Quality Conditions
- Regulatory Framework
- Onondaga County's Infrastructure Upgrades
- Ambient Monitoring Program
- Metrics of Water Quality
- Onondaga Lake Response to Upgrades
- *Save the Rain* Program
- Revised Phosphorus TMDL
- Monitoring Program (Gray and Green Infrastructure)
- Future Monitoring Goals

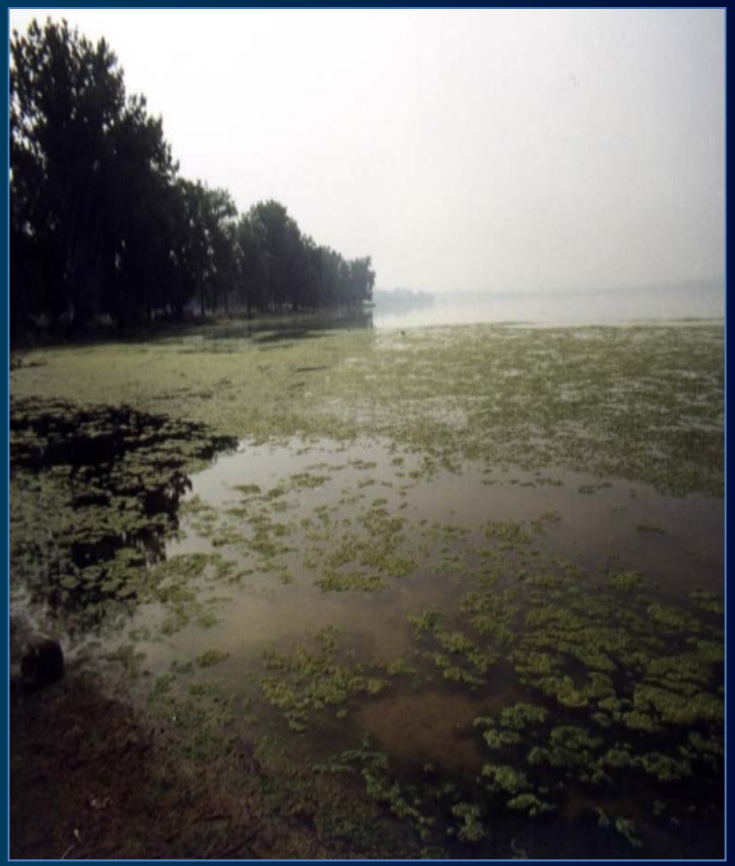
Onondaga Lake

- Morphometry:
  - area = 12 km^2
  - mean depth = 10.9 m
  - maximum depth = 20 m
- Stratification: dimictic
- Chemistry: hardwater, alkaline
- Flushing rate: ~ 4 times/year
- Watershed: 738 km^2; population ~ 450,000
- Location: metropolitan Syracuse, NY



Historically Degraded Water Quality and Habitat Conditions

- high concentrations of phytoplankton; algal blooms common
- poor water clarity
- rapid loss of dissolved oxygen (DO) from lower waters
- severe depletion of DO in upper waters during fall turnover
- PCBs, dioxins, mercury



Regulatory Framework

Consent Decree - 1989

ASLF, AG, NYSDEC file complaint against OC alleging violations of its permit

Amended Consent Judgment (ACJ) - January 1998

Federal Judge signs ACJ ordering interim wastewater treatment plant improvements agreed upon

15-year $380M Phased Compliance program with CWA by <u>December 2012</u> (Projects costs >$600M)

- Metro Upgrades
- CSO Abatement Projects
- Ambient Monitoring Program (AMP)

Metropolitan Syracuse Wastewater Treatment Plant (Metro)

- Provides treatment for 245,000 residents, industrial and commercial customers
- Treats 62 MGD on average; full secondary & tertiary treatment up to 126 MGD; hydraulic capacity of 240 MGD
- Discharges to surface of Onondaga Lake; 17% of annual inflow
- Effluent contributed ~ 90% of ammonia load; ~ 60% of phosphorus load to lake

Metro Upgrades

Biological Aerated Filter (BAF)

On-line January 2004

- Polystyrene bead filter media
- Year-round nitrification
- BAF system achieved Metro Stage III SPDES

✓ Onondaga Lake compliant with NYS ammonia standards and removed from 303(d) List (2008)

Actiflo® System (HRFS)

On-line February 2005

- High rate flocculation/settling of TP
- Actiflo® system met Metro Stage II SPDES Interim P limit of 0.12 mg/L on schedule (4/1/06)

Onondaga Lake Monitoring Program

Onondaga Lake Monitoring Program:

Late 1960s: First comprehensive water quality baseline study
"The Onondaga Lake Study" (OC 1971)
1970-1997: Conducted annually by the County

Onondaga Lake Ambient Monitoring Program (AMP):

1998 - present: Robust ACJ mandated program

Onondaga Lake:

- water quality (trophic state parameters, indicator bacteria, and additional ancillary parameters)
- biological (plankton, macrophytes, macrobenthos, fish)

Tributary:

- water quality/storm event
- biological (macrobenthos)

AMP Metrics: Desired Endpoints

Developed to …

- Meet the challenges of tracking responses to remedial measures and evaluate compliance with WQS
- In consultation with Onondaga Lake Advisory Committee and Regulatory Agencies (NYSDEC & USEPA)

Drawn from ACJ and lake's regulatory classifications -

1. Does the lake support water contact recreation?

   Indicator bacteria and water clarity

2. Is the system aesthetically appealing?

   Water clarity, bloom frequency, intensity & duration, Algal community structure

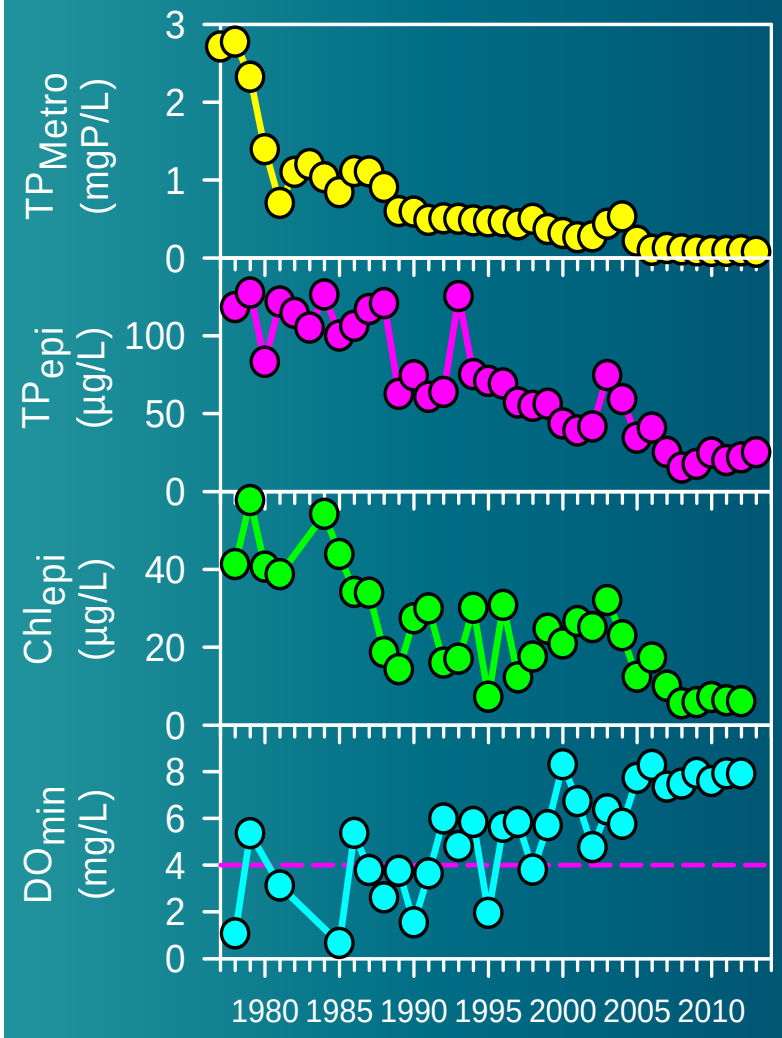
3. Do water quality conditions protect aquatic life?

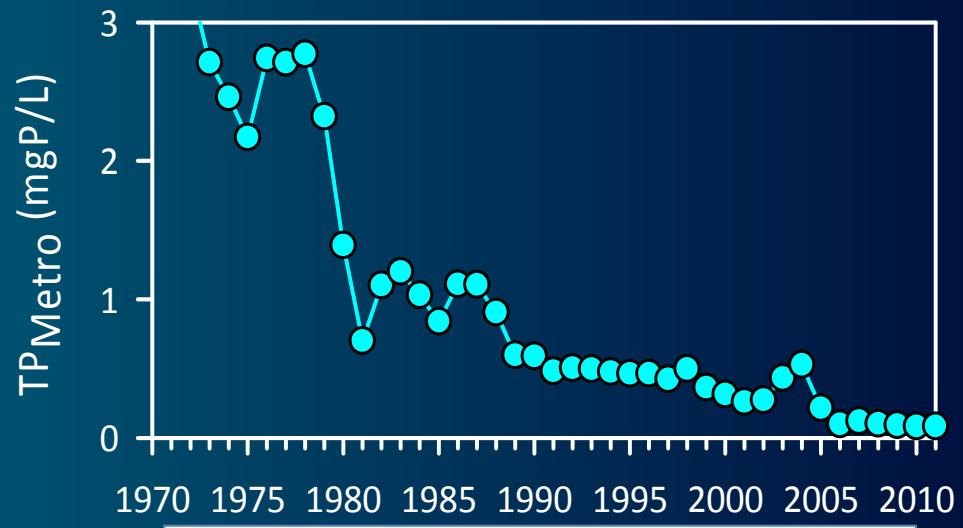
   Ammonia-N, Nitrite-N, Dissolved Oxygen

4. Is there a sustainable recreational fishery?

   Species and reproduction

Lake Response to Phosphorus Loading Reductions

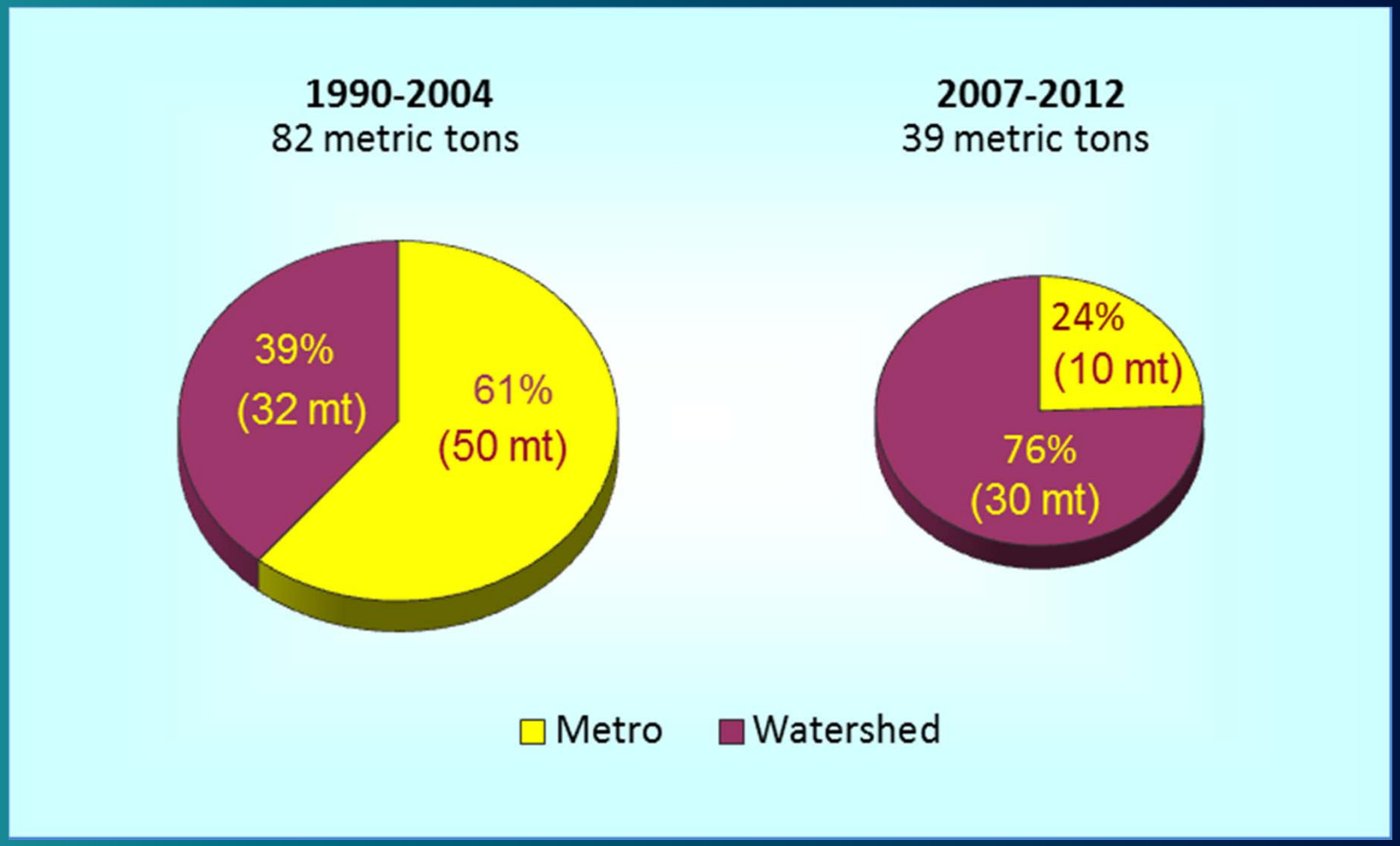




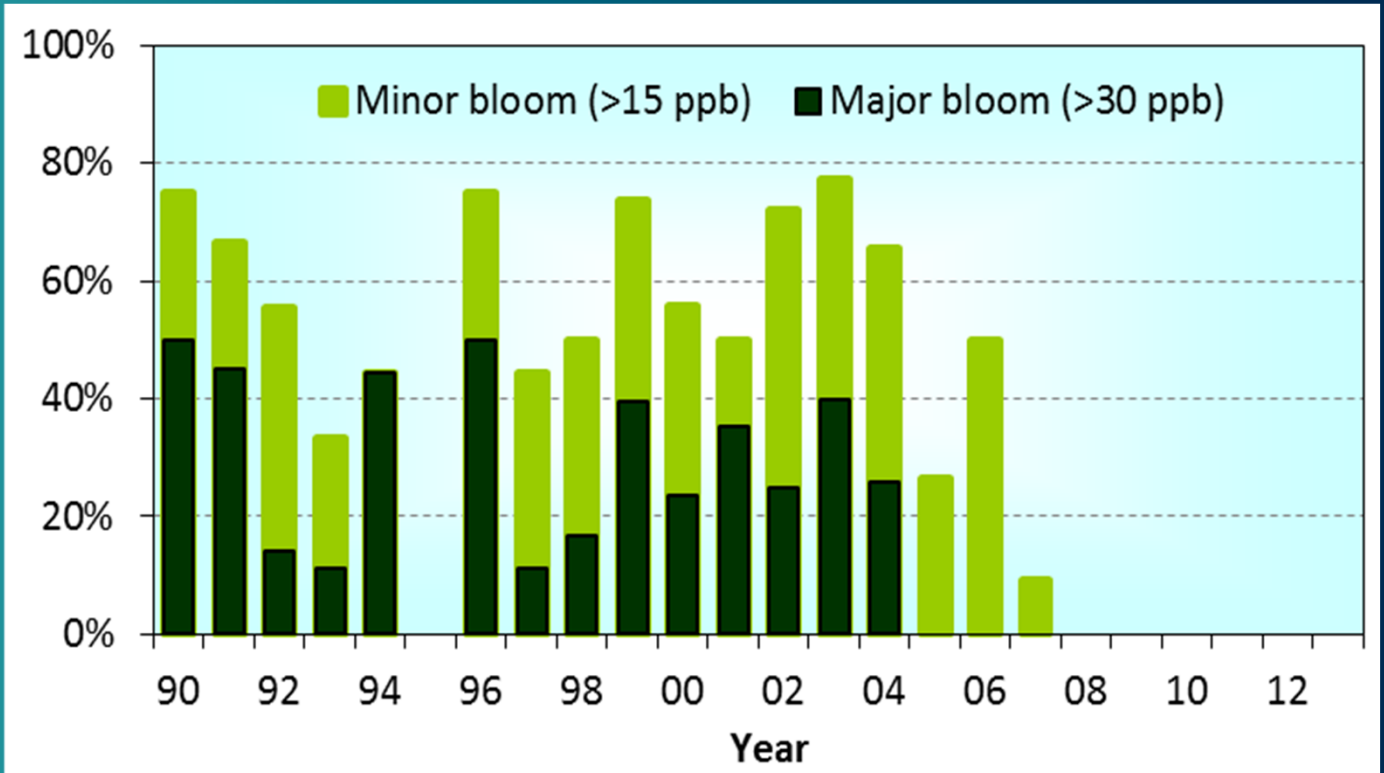
~ 100 fold decrease in TP_{Metro} from 1970 to 2013

- ✓ Consistent compliance with the NYS standard for DO in upper waters since 1999

Phosphorus Loading to Onondaga Lake
- Metro and Watershed Sources



Algal Bloom Frequency During Summer



No blooms were observed during summer in 1995, 2008, 2009, 2010 , 2011, 2012, or 2013

no major algal blooms since 2004

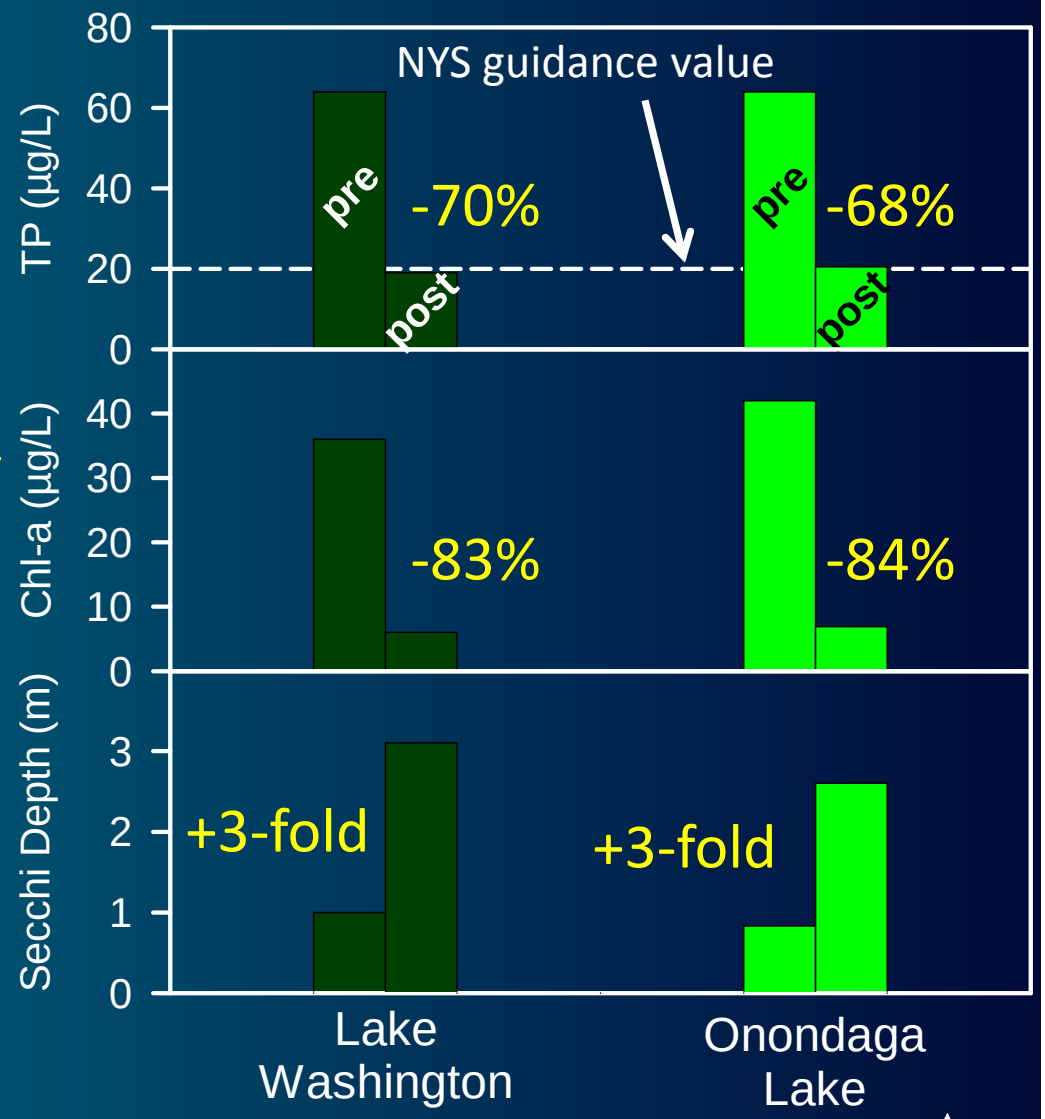
no minor algal blooms since 2007

cyanobacteria (bluegreen algae) are no longer an important component of the algal community

Shift in Onondaga Lake's trophic status from **E**utrophic to **M**esotrophic

Comparison to the Recovery of Lake Washington (Seattle, WA)

- the pinnacle of lake restoration



Expanded Macrophyte Coverage

and Fish Community…

- Early 1900s ~ **18** fish species identified
- 93% of catch in 1946 was Common Carp
- 2000-2012 AMP captured 49 different fish species
- Currently supports a thriving warm water and cool water fish community

ACJ 4th Stipulation (2009)

Extended the ACJ through 2018

Regulatory Goals

1. Capture & Treat 95% of Annual CSO Volume by reducing the amount of stormwater runoff/untreated sewage reaching the lake and its tributaries
2. Achieve AWQS in Tributaries and Onondaga Lake

Green: "*Save the Rain*" Program

[green roofs/permeable pavement/tree plantings/rain gardens/cisterns]

- ✓ promotes sustainability
- ✓ ensures cost effectiveness
- ✓ multiple community and environmental benefits

Gray: CSO Abatements Projects

[storage and treatment]

Revised Phosphorus TMDL

Phosphorus TMDL (1997 Phase I) updated in May 2012

- AMP data
- Enhanced Modeling (Watershed, Lake, Sediment)
- Paleolimnological Studies

NYS Phosphorus Guidance value - 20 µg/l numeric target

- for protection of primary and secondary contact recreation designated uses of the Lake; and
- protective of fishing best use

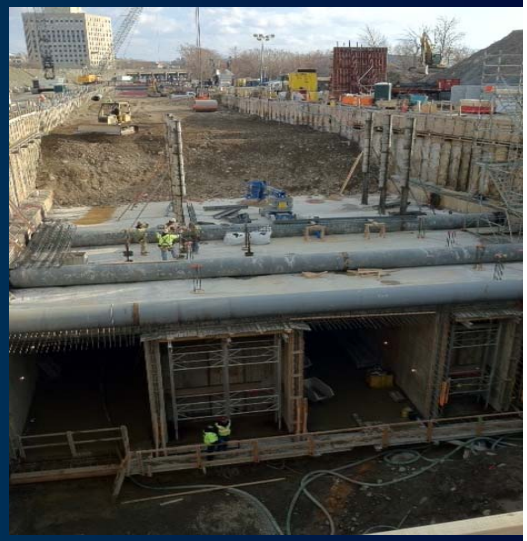
WLA targets 39% CSO load reduction (by 12/31/2018)

- CSO abatement projects (95% volume capture)

Gray Monitoring Program

Clinton Storage Facility (6.5 MG underground storage):

- 9 CSOs captured during wet weather, stored and sent to Metro for treatment
- Post event flushing by parking lot stormwater



Monitoring Program:

- Goal: To evaluate compliance with WQS and CSO load reductions of bacteria and nutrients (TP and TN)
- High frequency in-stream sampling to determine the effectiveness of infrastructure projects.
- Monitoring of select CSO outfalls for quantity and quality.
- Challenges: sample frequency/locations/protocol (grabs, transect and depth integrated)

Green Monitoring Program (2013-2014)

In collaboration with Syracuse University, SUNY-ESF in consultation with OC and CH2M Hill

OnCenter Green Roof

Objective: In-site monitoring effort to verify performance of individual GI projects (10 monitoring sites).

- Gauge infiltrative performance to estimate storage capacity for each installation
- Monitor water quality for nutrients (N and P), metals (Pb, Cd, Ni, Zn); products of fossil fuel combustion (PAHs/VOCs); other major Ions (Cl, SO_4)

Completed 147 projects to-date:

over 100 MG of stormwater captured!

Goals for Future Monitoring

- Continue Phosphorus TMDL Compliance Monitoring Program to evaluate extent of achieving in-lake TP criteria and beneficial uses.
- Continue GI and Gray Monitoring Programs to determine CSO capture volume and load reductions.
- Establish protocols for in-stream and CSO outfall sampling programs to
- Collect representative samples and to ensure post-construction monitoring programs are consistent with the approach outlined in USEPA's "*CSO Post Construction Compliance Monitoring Guidance*", dated May 2012.
- Post-construction monitoring to evaluate water quality improvements of individual gray projects (2014-2018) and following completion of all GI and gray projects (2018).

Questions?

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Visit Onondaga County's web sites for more information:

www.ongov.net/wep

www.savetherain.us